



THEODOR HOLM NELSON has earned the right to say "I told you so."

Thirty years after conceiving of Xanadu, a computerized repository of human knowledge—with any document, image, animation, or note of music instantly accessible to anyone, anywhere—this iconoclast of the computer world is finally seeing his dream come true. His software scheme is being tested, and the rest of the world will be able to use the initial component of Nelson's system next year, when Xanadu software is commercially released.

Nelson created the concept of hypertext. His pioneering book, *Computer Lib/Dream Machines*, published in 1974, inspired the leaders of the personal computer revolution while leaving him on the outside looking in. Now he is telling anyone who will listen—including IBM and members of the U.S. Senate—how right he was when he envisioned Xanadu. Although Nelson's dream was long deemed impractical by computerdom's experts ("chip-monks," as he calls them), the imminent availability of Xanadu software bears witness to his vision.

The Xanadu Hypermedia Information Server program, which will make Nelson's dream a reality, is software from the Xanadu Operating Company, owned by Autodesk, publisher of the top-selling CAD/CAM package, AutoCAD. At first, the Xanadu Hypermedia Information Server will run on Sun

HYPERTED

The man who gave us hypertext hopes to make a dream come true with Xanadu, a visionary system for sharing human knowledge.

BY STEVE DITLEA

PHOTOGRAPH BY ROBERT HOLMGREN



workstations to support the complex links for referencing documents and will be followed by server programs for higher-end IBM-compatible PCs, Apple Macintoshes and NeXT computers.

Xanadu's payoff for PC users should be the democratization of electronic publishing, as well as access to new and enriched forms of information services. Those who run Xanadu on their local area networks will have a sophisticated electronic filing system linking related documents and materials, with version control and comparison (lawyers take note), as well as commentary (computer "post-it" notes ad infinitum). For users of AutoCAD, Xanadu should mean a more efficient way of storing and retrieving elaborate computer-assisted design and manufacturing databases (cheers from engineers and architects).

With Xanadu running, you could read this profile of Nelson and his unswerving (some would say obsessive) vision of computopia on your computer screen, using the increasingly familiar principles of hypertext (a term Nelson coined) to branch off and learn more about areas of particular interest, perhaps triggering a display of hypermedia (another Nelsonism) with a video of him or one of the scenes described here. In addition, you might encounter written commentaries posted by Nelson after the article was published, along with commentaries from friends, enemies, colleagues, critics—and chipmonks. By selecting the appropriate links between documents, you could see as much or as little ancillary information as you wanted. In a later phase, you might attach your commentary and be rewarded with royalty payments from those who read your words.

For now, you'll have to settle for these linear words, as humans have had to do throughout the dark ages B.N.—before Nelson.

Mr. Nelson Goes to Washington

The scene could be out of a new-tech remake of the movie classic *Mr. Smith Goes to Washington*. Here, in a Senate hearing room on a warm, late summer's day in the company of such distinguished dark-suited witnesses as the Librarian of Congress and the chancellor of Vanderbilt University, sits a tall, wizened yet boyish figure dressed in an ill-matched, double-breasted jacket, windowpane-checked shirt and patterned tie.

He's here to testify before Senator Albert Gore's Subcommittee on Science, Technology and Space, explaining "computer technology and the new age of information" at the behest of a committee staffer who later describes him as "representing the next century of computing." Ted Nelson rises extemporaneously to the occasion.

In a tone that Jimmy Stewart might use, Nelson says,

"I'm not only honored to be here, I'm very moved. Because for so many years I've been consigned to the lunatic fringe of computerdom—in fact, thought by some to *define* the lunatic fringe of computerdom."

"And you feel at home here, today, is that it?" jokes Senator Gore (D-Tennessee), tan, telegenic and blessed with excellent timing. The rows of spectators in the hearing room respond with laughter.

Nelson continues, "Well, when I said that personal

"The easiest way to say this is, 'I have a dream.' The year 2020, the 2020 vision: a billion people are at their screens around the planet..."

computers would replace the typewriter, they said I was crazy. And when I said hypertext was the new step in literature, they said I was crazy. And when I said online libraries were coming, they said I was crazy... And now they call me a visionary."

More laughter, led by Gore.

At issue here is a bill introduced by Gore to formulate long-range information technology policy, including federal investment in a national computer network 50,000 times faster than the current network, linking U.S.-funded supercomputer centers at academic institutions across the nation. The proposed 1-gigabit network, endorsed by the Bush administration, is expected to set standards through the 1990s for high-bandwidth communications, including information systems connected to offices and homes. Several witnesses at the hearing compare the high-bandwidth computer network to the interstate highway system built with federal funds—as necessary for interstate commerce, as a way of keeping the Japanese at bay, as American as apple pie.

Only Nelson manages to sound a paean to private enterprise while suggesting that the network proposal may not be sufficient: "We're not looking for a handout... We believe that the capacities of the information providers of this nation are going to absorb your bandwidth in three months or so of when it opens.

"It's like the first Xerox machines... I was in various committee meetings where they were trying to decide whether a university could use a whole Xerox machine... And so, within a week, of course, the entire capability was sopped up. Similarly for open hypertext publishing..."

After a plug for Xanadu, Nelson concludes, "Now we look on you to give us the pathways, the superhigh-

ways for information to carry this stuff, but we think the private sector may be able to do a lot more than you think for the digital libraries of tomorrow."

With Gore vigorously agreeing and saluting private enterprise, this is one of Nelson's finest moments—in his own immodest estimation. Then again, he has trouble remembering his other finest moments.

The Purple Prophet at Big Blue

Ted Nelson suffers from chronic forgetfulness (as did 19th-century English poet Samuel Taylor Coleridge, who, when awakened from an exotic dream of Xanadu, struggled to recreate it in his poem *Kubla Khan*). One reason that Nelson envisioned hypertext and Xanadu was to find a way to computerize and cross-reference the millions of cards and pages of notes he accumulates (one thought or idea per page) so he wouldn't forget. He stored piles of his boxed, handwritten notes in warehouses in Poughkeepsie, New York, and in San Antonio, Texas, where they accumulated storage charges for years before being transferred to a warehouse near his home in California's Marin County.

If Nelson had his notes on Xanadu right now, he might recall another scene, just four days before his Senate appearance, when he addressed a small but avid audience at IBM's Thomas J. Watson Research Center. Much of his reputation as a curmudgeon arose from his unrelenting criticism of IBM; he noted, for instance, in *Computer Lib/Dream Machines* that "IBM is, to my way of thinking, the way the Soviet Union would be if the Soviet Union worked."

Nelson, still predicting IBM's demise while recognizing such positive accomplishments as the PC, is the last person you'd expect to see at IBM.

Yet here he is in an office building in Westchester County, north of New York City, pacing before and addressing two dozen casually dressed IBM researchers in a small seminar room at one of Big Blue's most prestigious labs. Sporting his sartorial trademark—purple shirt and purple socks—along with a conservative suit, his belt laden with pens and other paraphernalia, Nelson brings to mind a scholarly combination of Robin Hood and Cyrano de Bergerac, two of his childhood heroes. "I always carry pens like swords in a scabbard," Nelson ex-

plains later. "I'm like a swordsman with words, always ready for a fight."

Instead of a fight, Nelson is greeted with sympathetic smiles. "This is not my profession; this is my religion," he declares, launching into a freewheeling description of Xanadu. The room seems filled with willing converts. "I believe this represents the next stage in civilization, and it's absolutely imperative if there's to be any chance of human survival..."

Nelson's theology is simple: We've been living in an informational Babel of incompatible formats and protocols, with worldwide catastrophe looming. To save the planet, we must assure the availability of computerized documents that can be compiled, compared, footnoted and commented upon. With all the necessary links and inclusions, this universal literary system will promote an orderly controversy of ideas, resolving misunderstandings and beckoning a new millennium.

Ultimately, all publishing of magazines, books, movies, music and the like will be done with his open hypertext system "in that great computer in the sky, the storage repository, be it mainframe or network, to which we will all have access."

The McDonald's of Information

The Xanadu vision will remain incomplete until one important development, the implementation of which Ted Nelson has reserved for himself as sole licensee of Xanadu software for publishing with royalties. His name for this application is Public Access Xanadu, a "licensed and franchised storage and forwarding service run along the lines of McDonald's." Though the date may slip, Nelson predicts that Public Access Xanadu, or PAX, will begin operation in August 1991.

PAX will not deal with the public directly but will license franchises to "storage vendors," who will actually provide the licensed services and maintain the necessary support equipment.

Nelson envisions PAX-franchised Silverstands, information stands that are the equivalent of McDonald's, where billions of documents are served. Instead of the golden arches, Silverstands will be marked by the sign of the Flaming X, a PAX trademark—the torch of freedom burning forever.

Inside will be cheerful personnel in Star Trek-like uniforms signing up and assisting new PAX users, who can then access or publish documents at a workstation in the stand or telecommunicate with Xanadu from home or office. A monthly bill from a Silverstand would consist of charges for connect time, storage, transmission time, publication fees, publication registration fees and delivery, minus any credits for royalties from others reading the user's published words and/or images and sound.

As McDonald's does, Nelson expects to recruit, with at least \$400,000 in cash, hard-working, well-financed franchisees willing to be trained in operations at Xanadu Central, patterned along the lines of Hamburger University. To give franchisees "the feeling of belonging to something more than a brokerage firm," PAX will have a traveling core of generalists and scholars who will set the corporate culture and tone for the stands.

Nelson says of PAX: "This is an ideology. This is something to believe in."

—SD

For many years, those of little faith have argued that computer storage is too expensive to accommodate the massive memory needed to put every published document on earth online. The explosive growth of computer memory and resulting plunge in costs have brought Nelson's vision to the realm of possibility.

Still, his dogma's sticking point has been the problem that plagues all current databases: the proportionally greater lag in access time when the size and complexity of a data pool increase. But Xanadu, of course, is not just another database; programming breakthroughs assure the system's goal of unlimited growth, with storage and retrieval algorithms that keep increased access time to a logarithmic curve—nearly flat for a large information base.

Inveighing Against Substitutes

With the promised land in view, Nelson warns against the false prophets of current hypertext implementations. "They just lead to balkanization and chaos," he says of systems like Apple's HyperCard program, bundled with every Macintosh ("What if you want to add comments?"), and the much-touted charms of CD-ROM ("The good news is you can have 400MB on your desk; the bad news is you can have *only* 400MB. What good are 400MB? I want everything."). Only Xanadu, he says, has the potential to unify the complete realm of human knowledge.

For the true believer, authentic hypertext capability will begin with the imminent release of the Xanadu Hypermedia Information Server. Still, after years of waiting for Xanadu to materialize (a prototype was complet-

among the talented band of scientists and programmers attracted to Nelson's dream over the last decade, often contributing their time and ability during scarce leisure periods "in an atmosphere somewhere between Camelot and the Manhattan Project," as Nelson likes to describe it.

Today's Xanadu Operating Company came into being in April 1988, when Autodesk purchased an 80 percent interest in the firm (see "One Company Stakes Its Future on Innovation," *PC/Computing*, September 1989, page 86). As a result, the current president of Xanadu, Ron McElhaney, is Autodesk's vice president of engineering. And though Nelson is the originator, prophet, guru, propagandist and conscience of Xanadu, his current status does not include an official role in the Xanadu Operating Company.

As a Distinguished Fellow at Autodesk, which is headquartered in Sausalito, California, Nelson does get the wherewithal and time to travel extensively, spreading the word as he's doing at IBM (a week before, he was in Finland). According to Nelson, "I make these speeches about the great world repository, and it makes it sound as though the Xanadu Operating Company's contribution, a piece of software that you will be able to buy, is just some footnote. Whereas, in fact, it's what runs the whole thing."

In charge of software administration for Xanadu is Marc Stiegler, who cautions that the realities of bringing a product to market may cast a different light on some of Nelson's statements about upcoming programs. Already the relation of the software to Nelson's gospel, as set out in his self-published *Literary Machines* (Mindful Press, 1981; 3020 Bridgeway, #295, Sausalito, Calif. 94965, \$25), is a matter of dispute. As Stiegler puts it: "Whatever Ted says that is true, we say that's true; whatever Ted says is wrong, we say that's Ted."

All parties agree that within months the Xanadu Hypermedia Information Server will offer the first document filing system software to support all forms of digital data (text, graphics, video and audio) with two-way hypertext links for

branching to and from points of interest (also flexible "span-links" between groups of links) and the inclusion of documents within any other document without having to copy the entire text into it ("transclusion," which keeps all versions current).

In database vernacular, the server software is a "back end," meant to maintain the links between documents but too complex in its demands for the user seeking to retrieve a document and related materials to access directly.

For that, third-party firms are expected to offer application programs, or "front ends." The company will

"The hypertext concept, which has caught on widely, is simply that nonsequential writing is going to be a very important new medium."

ed in 1988 but was put aside to add more features in the new design), how can even the faithful be certain that the product isn't yet another mirage?

"For the first time Xanadu has offices, salaries, PERT charts, professional software development managers. It's a whole new organization. They will definitely deliver the products they're talking about." So says Eric Drexler, author of the acclaimed *Engines of Creation: The Coming Era of Nanotechnology* (Anchor Press, Doubleday, 1986) and a key contributor to Xanadu's software coding. Drexler, chief programmer Mark Miller and keeper of the flame Roger Gregory are

issue its own "exemplar front end" packages for IBM PC and Macintosh computers to provide generic capability to edit, save and retrieve hypermedia and "do for Xanadu what MacPaint and MacDraw did for the Macintosh," according to Stiegler. "But there's no right way to design a front end. We expect as many front-end programs as there are specialized informational needs." Obvious candidates for Xanadu front ends are legal, academic and CAD/CAM file retrieval applications.

In order to keep the core software as universal as possible, the Xanadu team is concentrating on back-end issues. A standard joke: "How many Xanadu people does it take to screw in a light bulb? None. That's a front-end problem."

At the heart of Xanadu software is a new data struc-

ture invented by Eric Drexler and implemented by the programming group. The structure allows access to as little as a single byte of data or the entire Xaniverse of available documents.

Thanks to this data structure, documents stored and referenced on one network can quickly be integrated into or accessed by any other computer system running Xanadu. The identifier should not be confused with another Xanaword—*xandle*. Like a handle on CB radio, a xandle is a unique identifying name for each user. Special xandles are already being reserved for a \$100 fee by the company. Among the xandles reserved by Nelson are Generalistimo and Strategic Hamlet. (For Nelson's plans to promote public access to Xanadu, see "The McDonald's of Information," page 203.)

Other Hypertext Products

In the jargon of industry press releases and product announcements, the term *hypertext*, unmoored from the initial vision of its creator, describes a wide variety of products. And according to Danny Goodman, a HyperCard developer and the author of *The Complete HyperCard Handbook*, users are confused. "The name [HyperCard] is unfortunate," says Goodman. "In ideal hypertext, anything—any bit of art, text or music—can become a 'but-

ton.' In HyperCard, that's just not possible. You can't really create buttons on the fly."

Hypertext has, however, inspired a number of useful products for the PC. Although none of these delivers the power and flexibility of Nelson's ideal system, all of them can help you organize information into cards and stacks and establish links between related entries.

—PATRICK WARD

LinkWay 2.0

Targeted for educational markets, LinkWay organizes information into pages and folders and includes support for videodiscs and other multimedia peripherals.

LIST PRICE: \$98, single; \$686, network.

REQUIRES:

512K RAM, DOS 2.1 or later.
IBM Educational Systems
P.O. Box 2150
Atlanta, Ga. 30055
(800) 627-0920

Provo, Utah 84604

(800) 543-6546

(801) 375-3700

Transtext

A word processor that lets you create hypertext links to many other commercially available applications.

LIST PRICE: \$89

REQUIRES:

250K RAM, DOS 2.0.
MaxThink
44 Rincon Road
Kensington, Calif. 94707
(415) 540-5508

Cognetics Corp.

55 Princeton-Hightstown Road
Princeton Junction, N.J. 08550
(800) 229-8437
(609) 799-5005

Guide 3.0

Guide runs under Windows or on the Macintosh and lets you author and read hypertext

documents including text, graphics, audio and video.

LIST PRICE: \$295 (PC version).

REQUIRES:

640K RAM, DOS 3.1 (PC version), Windows 2.03 or later.
OWL International Inc.
2800 156th Ave. SE
Bellevue, Wash. 98007
(800) 344-9737
(206) 747-3203

HyperWriter 2.0

A hypertext authoring tool with audio and video capabilities and a limited scripting language.

LIST PRICE: \$299.95

REQUIRES:

640K RAM; DOS 3.0; CGA, EGA or VGA monitor.
Ntergaid
2490 Black Rock Turnpike
Suite 337
Fairfield, Conn. 06430
(203) 368-0632

Spinnaker Plus 2.0

A hypertext programming environment for developing and running custom information management applications.

Runs in both Macintosh and Windows 3.0 environments.

LIST PRICE: \$495

REQUIRES:

Mac Plus (for Mac version); DOS 3.1 or later, Windows 3.0 and a minimum of 2MB RAM (PC version).
Spinnaker Software Corp.
201 Broadway
Cambridge, Mass. 02139
(617) 494-1200

Folio Views 2.0

An information management system that lets you compress large text files into a customized "infobase" and create cross-referencing links.

LIST PRICE: \$495

REQUIRES:

512K RAM, DOS 2.0.
Folio Corp.
2155 N. Freedom Blvd.
Suite 150

Hyperties

An interactive system that lets you create hypertext documents and manuals from a variety of media, including existing files, online information, scanned material and video.

LIST PRICE: \$349 for version 2.0; slightly more for 3.0.

REQUIRES:

640K RAM, DOS 2.0.

Back to the Future

The Xanadu dream dates to the fall of 1960 and Nelson's term project for a graduate course at Harvard on computers in the social sciences. The inspiration for Xanadu extends back another two decades, with an article by Vannevar Bush titled "How We May Thank" in the July 1945 issue of *The Atlantic Monthly*. Anticipating the information overload of today, Bush argued for the creation of a device he named a "Memex," an electronic desk that provides access to any text on any subject in seconds. Realizing that such a system would require capabilities similar to paper-based literature and publishing, including citation, historical backtrack and attribution for royalty payments, Nelson devised a wish list for Xanadu. Then he set about to make it a reality, writing thousands of lines of code in the early '60s. Since then, he has concentrated on design, leaving the actual coding to others.

In 1964, Nelson came up with the term *hypertext* for the nonsequential writing with free user movement made possible by Xanadu. Using the prefix *hyper-* from mathematics, where it means "extended" or, as in *hyperspace*, "having more than three dimensions," he coined a word he was certain would catch on like wildfire. When it did, more than 20 years later, it reminded people of the use of *hyper-* in psychology and medicine, where it denotes something extreme or pathological.

"There is this awkward tension of terminology," Nelson admits. The tension is hardly alleviated by such clumsy usage as the announcement for Scholastic's new HyperScreen, "The revolutionary program that brings hyperpower to everyone's classroom computer."

To many computer users, hypertext was an incomprehensible notion until 1987, when Apple Computer ace programmer Bill Atkinson created a popular note-card-style software implementation of hypertext, the infamous HyperCard.

Bundled with every Macintosh sold since then, HyperCard's hot buttons have become available to over 1 million users, but its hypertext capabilities are as limited in comparison with Xanadu's as Microsoft BASIC (still bundled with virtually every MS-DOS computer sold) is when compared with an efficient, structured programming language such as C. (For more on HyperCard and similar programs for the PC, see "Other Hypertext Products" on page 209.)

During HyperCard's development, Apple gave Ted Nelson short shrift, inviting him to its Cupertino, California, headquarters, picking his brain at various levels of the company, from President John Sculley on down. Nonetheless, Nelson remains sanguine: "I don't feel I was exploited by Apple. Their bringing out HyperCard gave me a lot of notoriety."

In fact, Nelson's notoriety within the computer industry began in 1974, when he published his oversize-format *Computer Lib/Dream Machines*, credited as the first personal computer book. A humanist's-eye view of computers and the culture surrounding them, Nelson's individualistic tome influenced many of personal computing's soon-to-be successful entrepreneurs. As Bill Gates, chairman of Microsoft, once recalled for journalist Howard Rheingold, "I came across Ted Nelson's

"We [need] this kind of controversy-management system to prevent the ecological disasters of tomorrow..."

—Excerpts from Ted Nelson's *Senate Testimony*, September 15, 1989.

book when I was in college, not long before I founded Microsoft. And Nelson's vision of what personal computers could become was certainly inspiring to me."

In 1987, Gates's Microsoft Press published a revised edition of *Computer Lib/Dream Machines*. [Editor's Note: The author of this article was the agent for Nelson's book contract with Microsoft Press but no longer has a financial interest in any of Nelson's projects.] The new edition includes some self-congratulatory remarks by the author, printed in italics. For example: "In going through this material again, I am amazed to see most of the important world issues of today clearly foreseen. Starvation-filled lands, pie-in-the-sky defensive systems, and freedom of information will remain issues, unfortunately, for the indefinite future."

For all of his prescience, some of Nelson's revisions to *Computer Lib* acknowledge that he was wrong about certain things, like the TRAC language having a big impact: "It didn't. (I even tried to argue Bill Gates out of BASIC, I think it may have been in '76. That's funny enough to admit.) I also thought the Apple II, with no lower case, had no future."

Once Xanadu is up and running on a large enough system, Nelson wants to pursue his other interests, which include filmmaking. He may even take advantage of one of the rewards of his notoriety—a standing offer to use the high-tech editing facilities at Lucasfilm.

"I still think of myself as a philosopher and filmmaker, primarily," remarks this computer prophet. "There's more to Ted Nelson than hypertext—and more to hypertext than anyone has seen." ■

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